

~~Meeting Log & Study Guide~~

Fire-Risk Analysis of Boulder Mountain P
OSMP Studies 4381

Study



FIRE-RISK ANALYSIS OF BOULDER MOUNTAIN PARKS
City of Boulder, Colorado

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FIRE-RISK ANALYSIS OF BOULDER MOUNTAIN PARKS

City of Boulder, Colorado

Many factors and variables determine the fire danger of an area. These include: the slope of the land, whether that land faces north, south, east or west; the type of vegetation and density of grasses, shrubs, and forests; the fuel type (fallen trees and branches, leaves, and undergrowth); density of the fuel; the time of year; local weather; wind direction and intensity; even the time of day. This project analyzed the fire danger using only three of these factors to estimate the level of fire danger in the City of Boulder's Mountain Parks during late summer assuming midday sun conditions: the slope, the aspect and the vegetation type.

Boulder's Mountain Parks encompasses about 5,000 acres directly west of Boulder. The park includes the Flatirons, Boulder's scenic backdrop, and the peaks directly behind the Flatirons. In 1899, Congress granted 1800 acres of Mountain Parks as a gift of government land to Boulder. By early in the century, Mountain Parks had expanded to its current size. The Department of Parks and Recreation, Mountain Parks Division, is currently working with landowners adjacent to the western edge of the park to purchase an additional 350 acres of sensitive land. The division is also holding public meetings and collecting data to develop a forest management plan. This plan will include a fire analysis, however, data needed to run a sophisticated fuel model are still being collected. The following report summarizes my evaluation of the fire danger within the park using ARC/INFO based on aspect, slope, and vegetation type assuming late summer conditions.

DATA AND COVERAGE SETUP

All raw data used in this project were FTP'd into my Metropolitan State College of Denver account from either the City of Boulder's Department of Parks and Recreation FTP site or the Colorado State University CORRC site. Boulder Mountain Parks is located on two U.S. Geological Survey 7½' quadrangles: Boulder and Eldorado Springs, Colorado. Files that were used in this project are listed below.

- Boulder DEM
- Eldorado Springs DEM
- Boulder hydrography (.e00 format)
- Eldorado Springs hydrography (.e00 format)
- Boulder transportation (.e00 format)
- Eldorado Springs transportation (.e00 format)
- Mountain Parks Vegetation Types (ArcView shapefile)

These files were imported into ARC/INFO, merged, then clipped to the boundaries of Boulder Mountain Park. Procedures used to develop the coverages are summarized in Appendix A. By default, ARC/INFO converts the polygon attribute table of an ArcView shapefile into a topology table and an arc attribute table without retaining its polygon attributes. Therefore, ArcView shapefiles were imported into ARC/INFO specifying the 'type' subclass. Data received from the City of Boulder was in stateplane coordinates. The vegetation, hydrography and transportation coverages were projected to utm.

ANALYSIS

The analysis was conducted to estimate the fire danger of a slope facing a certain direction and having a vegetation cover of a certain type. For example, what would be the fire danger for a south facing, Ponderosa savanna on a slope of 25% in late summer? This type of question was asked for all land within the park. To estimate the fire danger, a grid was created from the combined DEM for slope and aspect. The vegetation coverage was converted to a grid. The grids were then reclassified using lookup tables as follows:

Aspect

- North : 315° to 45°
- East : 45° to 135°
- South : 135° to 225°
- West : 225° to 315°

Slope

- 0% to 30%
- 30% to 70%
- Greater than 70%

Vegetation

- Grassland and Savannah
- Shrubland
- Woodland
- Forest
- Riparian areas
- Rock and Talus
- Controlled Burn areas
- Historic Development.

It was determined that to estimate the fire danger for these three variables, the three grids would have to be added together to obtain a combined effect. Unique codes were assigned to each of the above categories so that when these codes were added together, the resulting code would identify the cell in terms of its aspect, slope, and vegetation type. The unique codes assigned, are shown in Table 1. I had originally thought that the 'union' command could be used, however, 'union' does not add the codes in the coverage attribute tables together. If the 'union' command had been used, every possible circumstance would have to be queried.

The three grids were added using the 'addition operator' in GRID. GRID accepts only integers and the vegetation types were defined using characters rather than integers. Prior to conversion to a grid, an item converting 'cover' types to integers was added to the polygon attribute table using joinitem. The vegetation 'cover' item was then sorted in alphabetical order. Procedures for analysis are shown in Appendix A.

Once the grids were added and the resultant grid obtained, a reclassification table was made to assign each value in the grid value attribute table a risk code. These assigned risk codes are shown in Table 2. All three grids were given equal weight in this analysis. The risk codes assigned are based on accepted fire standards for slope, aspect, and vegetation during midday sun. The risk codes in Table 2 can be easily altered to estimate fire danger for other seasonal or time of day conditions. Fire standards are shown below.

Aspect

- North facing slopes: Low Risk
- East facing slopes: Medium Risk
- South facing slopes: Very High Risk
- West facing slopes: High Risk

Slope

- Greater than 70%: Low Risk
- 30% to 70%: Medium Risk
- 0% to 30%: High Risk

Vegetation

- Forest: Low Risk
- Riparian areas: Low Risk
- Woodlands: Medium Risk
- Shrubland: High Risk
- Grassland: Very High Risk
- Savannah (Ponderosa): Very High Risk

at midday - would E slopes be higher risk than west due to warming - however, W slopes are drier. reverse?

CONCLUSION

The resulting fire risk analysis was plotted using the AML in Appendix B and shown on the attached map "FIRE-RISK ANALYSIS OF BOULDER MOUNTAIN PARKS". The aspect, slope and vegetation coverages are also shown on the map for comparison. Although slope and aspect generally determine vegetation type, neither slope, aspect, nor vegetation appeared to, by itself, predetermine the fire danger in the park.

Based on this analysis, the areas of greatest fire danger during the late summer are located along the lower western, eastern and northernmost perimeter of the park close to urban and residential development. Ironically, a fire at these locations would most likely lead to property damage or loss of life.

REFERENCES

Boulder, City of, Fire Department, Wildland Fire Division, November 1998, personal conversation, Greg Toll.

Boulder, City of, Parks and Recreation Department, Mountain Parks Division, September 1998, raw data from their GIS section.

Colorado State University, CORRC, GIS digitized data sources: October 1998, <http://corrc.cnr.colostate.edu:8000/arnfquad.html>

National Wildfire Coordinating Group, January 1998, Fireline Handbook, NWCG Handbook 3, PMS 410-1, NFES 0065.

National Wildfire Coordinating Group, July 1994, Intermediate Wildland Fire Behavior S-290 Certified at Level 1, Student Workbook, National Interagency Fire Center, NFES #2378.

TABLE 1

CODES FOR THE SLOPE, ASPECT, AND VEGETATION GRIDS

| SLOPE | | 0% - 30% | 30% - 70% | > 70% | VEGETATION | Code |
|---------------|-------------|-----------------|------------------|-----------------|----------------------------|-------------|
| ASPECT | Code | (4) | (8) | (12) | Grassland/Savannah | (100) |
| North | (1) | 5 | 9 | 13 | Shrubland | (200) |
| East | (2) | 6 | 10 | 14 | Woodlands | (300) |
| South | (3) | 7 | 11 | 15 | Forest | (400) |
| West | (4) | 8 | 12 | 16 | Riparian | (500) |
| | | | | | Rock outcrops/talus | (700) |
| | | | | | Controlled burns | (800) |
| | | | | | Structures | (900) |

NOTES:

1. Unique codes were assigned to the Slope, Aspect and Vegetation grids and are shown in parentheses.
2. The resulting cell number in the final grid indicates the slope, aspect, and vegetation type of the resulting cell. For example: a 105 would mean the cell is north facing, has a slope of between 0% and 30% and is grassland or savannah; a 415 would mean the cell is forested, south facing and has a slope of greater than 70%.

TABLE 2

RISK CODES FOR FIRE-RISK COVERAGE

| Cell No. | Risk Code | Cell No. | Risk Code | Cell No. | Risk Code | Cell No. | Risk Code | Cell No. | Risk Code | Cell No. | Risk Code | Cell No. | Risk Code | Cell No. | Risk Code |
|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 105 | 3 | 205 | 3 | 305 | 2 | 405 | 2 | 505 | 2 | 705 | 7 | - | - | 905 | 9 |
| 106 | 3 | 206 | 3 | 306 | 3 | 406 | 3 | 506 | 3 | 706 | 7 | 806 | 8 | 906 | 9 |
| 107 | 4 | 207 | 4 | 307 | 4 | 407 | 3 | 507 | 3 | 707 | 7 | 807 | 8 | 907 | 9 |
| 108 | 4 | 208 | 4 | 308 | 3 | 408 | 3 | 508 | 3 | 708 | 7 | - | - | 908 | 9 |
| 109 | 2 | 209 | 3 | 309 | 2 | 409 | 2 | 509 | 2 | 709 | 7 | - | - | 909 | 9 |
| 110 | 3 | 210 | 3 | 310 | 2 | 410 | 2 | 510 | 2 | 710 | 7 | - | - | 910 | 9 |
| 111 | 4 | 211 | 4 | 311 | 3 | 411 | 2 | 511 | 3 | 711 | 7 | 811 | 8 | 911 | 9 |
| 112 | 3 | 212 | 3 | 312 | 3 | 412 | 2 | 512 | 2 | 712 | 7 | - | - | 912 | 9 |
| 113 | 2 | - | - | 313 | 2 | 413 | 1 | - | - | 713 | 7 | - | - | - | - |
| 114 | 3 | - | - | 314 | 2 | 414 | 2 | - | - | 714 | 7 | - | - | - | - |
| 115 | 4 | - | - | 315 | 3 | 415 | 2 | 515 | 2 | 715 | 7 | - | - | - | - |
| 116 | 3 | - | - | 316 | 3 | 416 | 2 | - | - | 716 | 7 | - | - | - | - |

NOTES:

| Risk Codes | Cell Occurences | Fire Danger |
|------------|-----------------|--|
| 1 | 331 | Low |
| 2 | 15380 | Medium |
| 3 | 13380 | High |
| 4 | 4081 | Very high |
| 7 | 2236 | Rock outcrops and talus -- barriers |
| 8 | 25 | Controlled burn areas -- very low |
| 9 | 201 | Historical structures -- proximity to very high risk areas |

APPENDIX A

DATA DICTIONARY AND DOCUMENTATION

FILES

The following files were copied into \$HOME/project/original directory from the City of Boulder FTP site on September 30, 1998.

- bldhyd.e00 (Boulder hydrography)
- eldohyd.e00 (Eldorado Springs hydrography)
- eldotran.e00 (Eldorado Springs transportation)
- bldtran.e00 (Boulder transportation)
- bldr.dem (Boulder DEM)
- elspg.dem (Eldorado Springs DEM)
- Veg7898.shp (Mountain Parks vegetation map – ArcView polygon shapefile)

The hydrography for the Boulder quadrangle was copied into my account from the Colorado State University CORRC account in October 1998.

PREPARATION OF COVERAGES

Boulder and Eldorado Springs DEMs

Import DEMs as a grid using DEMLATTICE from \$HOME/project/basemap

```
Arc:demlattice <in_file> <out_file>
Arc:demlattice bldr.dem boulder
Arc:demlattice elspg.dem eldspgs
```

Merge Boulder and Eldspgs DEMs into one using MERGE function in grid.

```
outgrid = merge (ingrid1,ingrid2,ingrid3)
Outgrid = merge (bldr.dem,elspg.dem)
```

Hydrography and Roads

Import ARC/INFO export files to the workspaces from \$HOME/project/original using IMPORT in ARC

```
Arc: import <cover> <in_file> <out_file>
Arc: import bldhyd.e00 ../streams/bldstrms (used for all .e00 files)
```

Project coverages from state plane to utm using PROJECT in ARC

```
project <cover|grid|file> <input> <output> {projection_file} {nearest|bilinear|cubic}
{out_cellsize}
project: cover bldstrms bstreams (all hydrography, transportation coverages)
[Use OUTPUT to define the output projection and END]
to finish.
Project: output
Project: projection utm
Project: units meters
Project: zone 13
```

Project: datum NAD27

Project: parameters

Project: end

[Warning: By selecting STATEPLANE as a projection, the datum will default to NAD27 if not specified.]

Build boulder stream coverage using BUILD

Usage: BUILD <cover> {POLY | LINE | POINT | NODE | ANNO.<subclass>}

build bstream line

Merge arc coverages using APPEND in ARC

Usage: APPEND <out_cover> {NOTEST | template_cover |feature_class...feature_class}
{NONE | FEATURES | TICS | ALL}

Arc: append roads line features

[Enter Coverages to be APPENDED (Type END or a blank line when done):]

Enter the 1st coverage: broads

Enter the 2nd coverage: eroads

Enter the 3rd coverage: end

(Build afterwards)

Vegetation Shapefile

Import files using SHAPEARC

(Shape polygon features must be converted into regions because there is no way to ensure that polygon shape features do not overlap. If no subclass is specified when converting, polygon features attributes will be added to the out_cover AAT. To finish the conversion to a regions coverage)

Arc: Usage: SHAPEARC <in_shape_file> <out_cover> {out_subclass}

Arc: shapearc veg7898 ../layers/vegetation type

[995 Type 5 (POLYGON) shape records in ./veg7898]

[1085 unique nodes built for ../layers/vegetation]

[995 preliminary region(s) appended to subclass type]

Clean vegetation using CLEAN command

Arc: clean vegetation

[Cleaning /USER1/BJ/BELLISJ/PROJECT/LAYERS/VEGETATION]

Create regions using REGIONPOLY command

Arc: Usage: regionpoly <in_cover> <out_cover> <in_subclass> <out_table>

Arc: regionpoly vegetaion forestcov type forestcov.safe

Reproject the coverage from no projection defined to utm

Arc: Usage: PROJECT <COVER | GRID | FILE> <input> <output> {projection_file}
{NEAREST | BILINEAR | CUBIC} {out_cellsize}

Arc: project cover forestcov vegcov

[Please define the input and output map projections]

[Use INPUT to define the input projection, OUTPUT]
[to define the output projection, and END to finish]

(project input as state plane and output as utm)

Project: input

Project: projection stateplane

Project: units feet

Project: zone 3451

Project: datum NAD83

Project: parameters

Project: output

Project: projection utm

Project: units meters

Project: zunits meters

Project: zone 13

Project: datum NAD27

Project: parameters

Project: end

[Warning: By selecting STATEPLANE as a projection, the datum will default to NAD27 if not specified.]

ANALYSIS

Slope

Determine slope from DEM using DEMSLOPE function in GRID

Grid: demslope = slope(basedemp,percentrise)

Reclass the demslope grid with the ignite_tab

Grid: slopedem = reclass(demslope,ignite_tab)

Grid: slopeignite = gridpoly(slopedem)

[Converting GRID SLOPEDEM to Coverage SLOPEIGNITE]

Aspect

Determine aspect from DEM using DEMASPECT

Grid: demaspect = aspect(basedemp)

Reclass demaspect

Grid: aspectdem = reclass(demaspect,aspect_tab)

(remap table for aspect to use for aspectdem

aspect_tab

0 45 : 1

45 135 : 2

135 225 : 3

225 315 : 4

315 360 : 1

Vegetation

Reclass tables in GRID require that input and output data be integers, characters will not be accepted.

Create a lookup table in analysis from which to transfer character codes to integer in the GRID using JOINITEM

Arc: Usage: JOINITEM <in_info_file> <join_info_file> <out_info_file> <relate_item>
<start_item> {LINEAR | ORDERED | LINK}

Arc: joinitem vegcov.pat vegcov.lut vegcov.pat cover cover

Create a grid from vegcov using POLYGRID

Arc: Usage: POLYGRID <in_cover> <out_grid> {value_item} {lookup_table}
weight_table}

Arc: polygrid vegcov veggrid

[Converting polygons from vegcov to grid veggrid]

Cell Size (square cell): 30

Convert the Entire Coverage? (Y/N): y

Number of Rows = 317

Number of Columns = 187

Percentage of Gridded Cells...100%

Arc: list veggrid.vat

| Record | VALUE | COUNT |
|--------|-------|-------|
| 1 | 0 | 6 |
| 2 | 100 | 8610 |
| 3 | 200 | 318 |
| 4 | 300 | 12827 |
| 5 | 400 | 11292 |
| 6 | 500 | 119 |
| 7 | 700 | 2236 |
| 8 | 800 | 25 |
| 9 | 900 | 201 |

Fire-Risk

Add the aspect and slope table using ADDITION operator in GRID (I had tried use the UNION command for coverages, but it just combines the coverages and the attribute tables but does not add the codes to make unique codes, therefore, you can't do anything with the polygons). The GRID operator "+" adds the values of two inputs on a cell-by-cell basis within the analysis window

ADDITION Operator in GRID

usage: outgrid = ingrid1 + ingrid2

Grid: firegrid = slopasgrid + veggrid (slopasgrid = slopegrid + aspectgrid)

[Running... 100%]

Convert the grid back to a polygon using GRIDPOLY

Usage: (*) GRIDPOLY (<in_grid>,{weed_tolerance})

Grid: firecov = gridpoly(firegrid)

[Converting GRID FIREGRID to Coverage FIRECOV]

[Creating labels...]

[Creating FIRECOV.PAT...]

Reclass Firegrid using reclass

Grid: Usage: (I) RECLASS (<grid>, <remap_table>, {DATA | NODATA},
 {in_item}, {out_item})

Grid: riskgrid = reclass(firegrid, fire_tab)

Reclass table for firegrid (see Table 2 in main report)

Fire_tab

Reclass firegrid for risk factors

- 1 = LOW
- 2 = MEDIUM
- 3 = HIGH
- 4 = VERY HIGH
- 7 = ROCKS
- 8 = BURNED AREA
- 9 = DEVELOPMENT

Reclass Firegrid

Grid: Usage: (I) RECLASS (<grid>, <remap_table>, {DATA | NODATA},
 {in_item}, {out_item})

Grid: riskgrid = reclass(firegrid, fire_tab)

Arc: list riskgrid.vat

| Record | VALUE | COUNT |
|--------|-------|-------|
| 1 | 331 | |
| 2 | 2 | 15380 |
| 3 | 3 | 13380 |
| 4 | 4 | 4081 |
| 5 | 7 | 2236 |
| 6 | 8 | 25 |
| 7 | 9 | 201 |

Turn riskgrid into a polygon using GRIDPOLY function in GRID

Grid: Usage: (*) GRIDPOLY (<in_grid>, {weed_tolerance})

Grid: riskcov = gridpoly(riskgrid)

[Converting GRID RISKGRID to Coverage RISKCOV]

Create lookup table for colors of riskcov map

| \$RECNO | GRID-CODE | SYMBOL |
|---------|-----------|--------|
| 1 | 1 | 43 |
| 2 | 2 | 74 |
| 3 | 3 | 83 |
| 4 | 4 | 110 |
| 5 | 7 | 2 |
| 6 | 8 | 29 |
| 7 | 9 | 28 |

DISPLAY

Clip slope and aspect coverages with riskcov using CLIP in ARC

Arc: Usage: CLIP <in_cover> <clip_cover> <out_cover> {POLY | LINE | POINT | NET
| LINK | RAW} {fuzzy_tolerance}

Arc: clip aspectcov riskcov aspectclip poly

Arc: build aspectclip poly

ASPECTCLIP.LUT

ENTER COMMAND >LIST

\$RECNO GRID-CODE SYMBOL

| | | |
|---|---|-----|
| 1 | 1 | 45 |
| 2 | 2 | 83 |
| 3 | 3 | 74 |
| 4 | 4 | 110 |

SLOPE.LUT

ENTER COMMAND >LIST

\$RECNO GRID-CODE SYMBOL

| | | |
|---|----|-----|
| 1 | 4 | 126 |
| 2 | 8 | 117 |
| 3 | 12 | 83 |

Create graphics files from the coverages and import into arcplot for display (see Appendix B)

Create a tic coverage from riskgrid using CELLVALUE in arcplot

Arcplot: mape riskgrid

Arcplot: gridshades riskgrid

Arcplot: cellvalue riskgrid *

<9 to END>

Example: The cell containing point (470775.000,4427697.911) has value 2

Change all colors on the amls and remake into graphics files

Plot as an eps file using the aml: pagelayout.eps (see Appendix B)

APPENDIX B

FIRE-RISK ANALYSIS OF BOULDER MOUNTAIN PARKS ARC PLOT LAYOUT AML

```
/* FIRE-RISK ANALYSIS OF BOULDER MOUNTAIN PARKS
/* City of Boulder, Colorado
/* Specify drawing environment for layout on 36 x 25 sheet of paper
/* includes border and neat lines
/* AML -- pagelayout.aml
/* display 9999
display 1040 2
pagelayout.eps
/* define the page units and size
pageunits inches
pagesize 36 25
/* create border around outside of map
lineset carto.lin
linesymbol 104
box .5 1 35.5 24.5
/* create neatline
linesymbol 102
box 1 1.5 35 24
/* create a space for the risk coverage graphics file 'risk.gra'
plot risk.gra box 23 4 33 24
/* create a space for vegcov coverage graphics file 'vegcov.gra'
plot vegcov.gra box 1.5 3 8 17.5
/* create a space for aspect coverage graphics file 'aspect.gra'
plot aspect.gra box 7 6 13.5 20.5
/* create a space for slope coverage graphics file 'slope.gra'
plot slope.gra box 12.5 9 19 23.5
/* define text for main heading
textquality proportional
textfont triumvirate bold condensed
textsize 54 pt
/* change textcolor to show up on black screen
/* textcolor white /* (de-comment when needed)
/* center text by trial and error
move 8.6 22
text 'FIRE-RISK ANALYSIS OF BOULDER MOUNTAIN PARKS'
textsize 48 pt
move 14.5 21
text 'City of Boulder, Colorado'
/* define text for subtitles of individual graphics files
textsize 36 pt
move 4.7 2.5
text 'Vegetation'
move 10.5 5.5
```

```
text 'Aspect'
move 16.3 8.5
text 'Slope'
textsize 48 pt
move 28.5 3.3
text 'Fire Risk'
/* define and locate the north arrow
markerset north.mrk
markersymbol 7
markersize 2
marker 17.4 4.6
/* Legend for Risk coverage
/* polygon shades
textsize 16 pt
shadeset colornames.shd
keybox 0.3 0.3
keyposition 21.8 10.5
keyseparation .2 .3
keyshade risk.key nobox
/* line attributes
lineset carto.lin
keybox 0.3 0.3
keyposition 21.8 5.8
keyseparation .2 .3
keyline riskline.key nobox
/* Title for legend box on Risk map
textsize 28 pt
move 22.3 11
text 'Legend'
/* Legend for Vegcov
textsize 12 pt
shadeset colornames.shd
keybox .2 .1
keyposition 1.5 6
keyseparation .1 .1
keyshade vegcov.key nobox
/* Legend for Aspect
keyposition 10.2 4.5
keyshade aspect.key nobox
/* Legend for Slope
keyposition 15.8 7.7
keyshade slope.key nobox
textsize 16 pt

/* Legend title for vegetation map
move 1.7 6.3
text 'Legend'
move 10.3 4.8
```

```
/* title of aspect
text 'Legend'
/* title of slope
move 15.9 8.0
text 'Legend'
/* Credits
textsize 12 pt
move 32 2.1
text 'by Janet Bellis, December 1998'
move 32 1.9
text 'using ARC/INFO Version 7.0.4'
move 32 1.7
text 'Metropolitan State College of Denver'
/* text in upper left corner for description of what I did to
/* build the risk map
textfont triumvirate bold condensed italic
textsize 32 pt
move 2 19.6
text 'DESCRIPTION'
textsize 16 pt
move 2 19.25
text 'The Fire Risk map was created by adding the unique'
move 2 19
text 'codes assigned to each classification in the'
move 2 18.75
text 'vegetation, aspect, and slope grids for late summer'
move 2 18.5
text ' and midday sun. Each grid was given equal weight.'
move 2.5 18.25
text 'For Vegetation:'
move 3 18
text 'Riparian and Forests : Low Risk'
move 3 17.75
text 'Woodlands : Medium Risk'
move 3 17.5
text 'Shrubland : High Risk'
move 3 17.25
text 'Grasslands and Savanah : Very High Risk'
move 3 17
text 'Rock outcrops and talus slopes : Barriers'
move 2.5 16.75
text 'For Aspect:'
move 3 16.5
text 'North Facing : Low Risk'
move 3 16.25
text 'East Facing : Medium Risk'
move 3 16
text 'West Facing : High Risk'
```

APPENDIX B

```
move 3 15.75
text 'South Facing : Very High Risk'
move 2.5 15.5
text 'For Slope:'
move 3 15.25
text '0% to 30% : High Risk'
move 3 15
text '31% to 70% : Medium Risk'
move 3 14.75
text 'greater than 70% : Low Risk'
/* Label of City of Boulder
textsize 32 pt
move 30 17
text 'City of
move 30 16.6
text 'Boulder'
/* Label for Boulder creek
textsize 24 pt
move 30.7 18.7
text 'Boulder Creek'
/* Label for Flagstaff Road
move 29.7 15.6
text 'Flagstaff Road'
/* Labeling the scale for each coverage
/* 1:24000 for Vegetation, Aspect, and Slope
textsize 14 pt
/*scale for vegetation
move 1.7 3
text 'Scale 1:34000'
/*scale for aspect
move 10 3
text 'Scale 1:34000'
/*scale for slope
move 15.8 6.5
text 'Scale 1:34000'
/* 1:18000 risk
textsize 18 pt
move 22.2 4.2
text 'Scale 1:22000'
/* tic labels on risk map
textsize 8 pt
move 26 20.7
text '472841,4430405'
move 28.8 20.7
text '473879,4430405'
move 22.4 15.7
text '470957,4427619'
move 29.7 15.4
```



```
text '474261,4427619'  
move 22.2 12.3  
text '470929,4426117'  
move 33.2 12.3  
text '476309,4426117'  
move 26.8 3.8  
text '473224,4421337'  
move 32.6 3.8  
text '476282,4421337'  
/*symbols for + and =  
markerset glyph.mrk  
markersymbol 22  
markersize .7  
marker 8.6 9.6  
marker 14.2 12.5  
/*symbol for = (just draw a line)  
lineset carto.lin  
linesymbol 103  
line 20.5 14 21.2 14  
line 20.5 13.8 21.2 13.8  
&return
```

GRAPHICS FILES

```
/*Fire Risk graphics file  
/* risk.aml  
display 1040  
risk  
clear  
mapextent riskcov  
shadeset colornames.shd  
polygonshades riskcov GRID-CODE RISK.LUT  
tics ticcov  
&return
```

```
/*Vegetation graphics file  
/* aml name: vegcov.aml  
display 1040  
vegcov  
mapextent vegcov  
mapunits meters  
mapscale 24000  
shadeset colornames.shd  
polygonshades vegcov COVER VEGCOV.LUT  
&return
```

APPENDIX B

```
/* Aspect graphics file
/* aspect.aml
display 1040
aspect
mapextent aspectclip
mapunits meters
mapscale 24000
shadeset colornames.shd
polygonshades aspectclip GRID-CODE ASPECTCLIP.LUT
&return
```

```
/*Slope graphics file
/* slope.aml
display 1040
slope
mapextent slopeclip
mapunits meters
mapscale 24000
shadeset colornames.shd
polygonshades slopeclip GRID-CODE SLOPE.LUT
&return
```